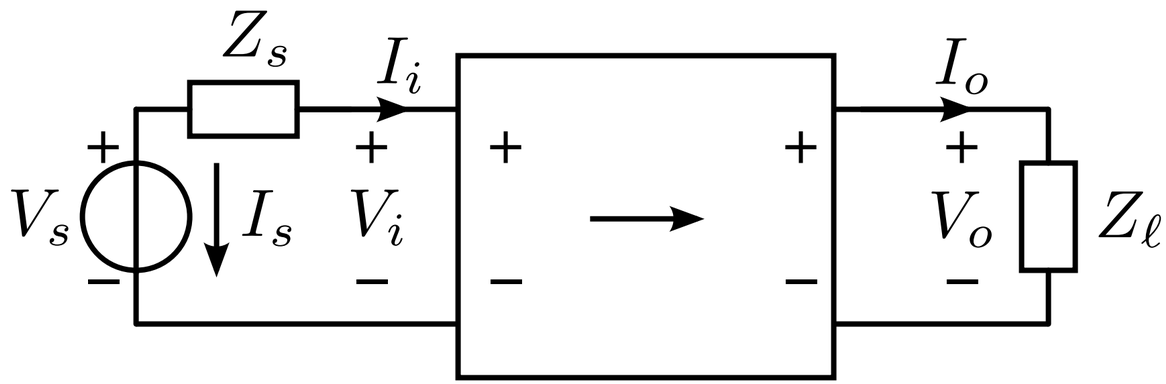
Structured Electronic Design

EE3C11

Determination of T1 matrix parameters

Anton J.M. Montagne

Determination of the transmission-1 two-port parameters

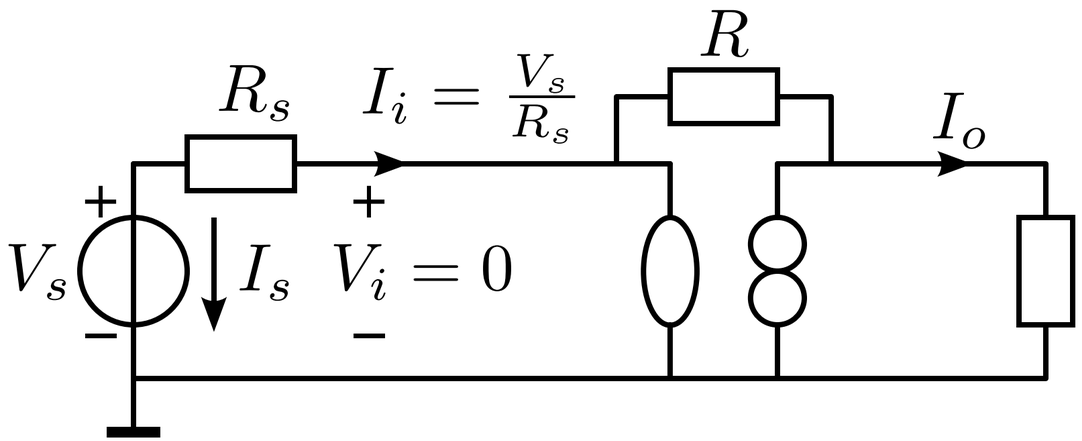


$$I_i = -I_s$$

$$\mu = \frac{1}{A} = \left.\frac{V_o}{V_i}\right|_{I_o=0} \qquad A = \lim_{Z_\ell \to \infty}\left(\frac{V_i}{V_o}\right) \qquad \zeta = \frac{1}{C} = \left.\frac{V_o}{I_i}\right|_{I_o=0} \qquad C = \lim_{Z_\ell \to \infty}\left(\frac{I_i}{V_o}\right)$$

$$\gamma = \frac{1}{B} = \left.\frac{I_o}{V_i}\right|_{V_o=0} \qquad B = \lim_{Z_\ell \to 0}\left(\frac{V_i}{V_o}\right) \qquad \alpha = \frac{1}{D} = \left.\frac{I_o}{I_i}\right|_{V_o=0} \qquad D = \lim_{Z_\ell \to 0}\left(\frac{I_i}{I_o}\right)$$

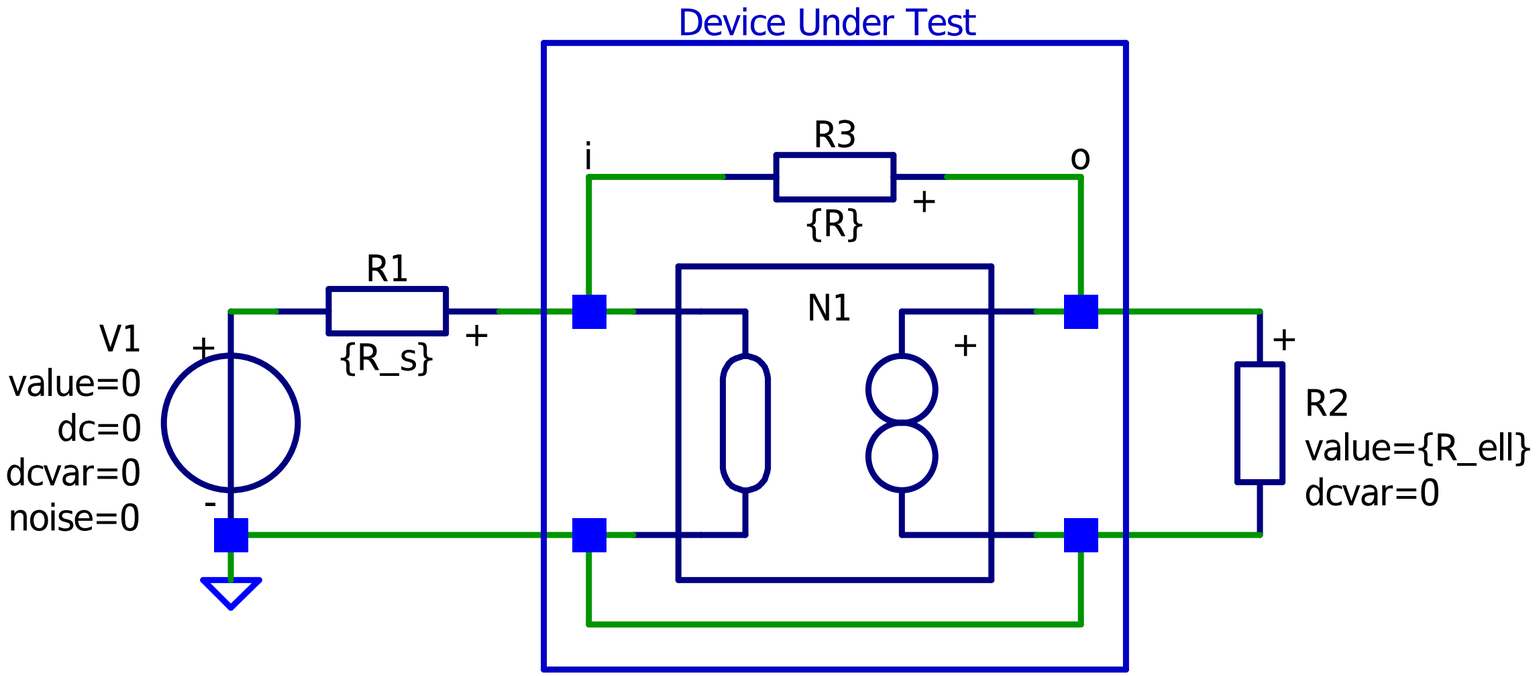
Example



$$A = \lim_{R_\ell \to \infty} \left(\frac{V_i}{V_o} \right) = 0 \qquad C = \lim_{R_\ell \to \infty} \left(\frac{I_i}{V_o} \right) = \frac{\frac{V_s}{R_s}}{-V_s \frac{R}{R_s}} = -\frac{1}{R}$$

$$B = \lim_{R_\ell \to 0} \left(\frac{V_i}{V_o} \right) = 0 \qquad D = \lim_{R_\ell \to 0} \left(\frac{I_i}{I_o} \right) = 0$$

Example



note: R2 is resistor model R_r

It has the matrix stamp of a voltage source
with zero voltage in series with a resistor

It adds its current to the vector with unknown variables

V_i

```
from SLiCAP import *
fileName = 'ABCD-test'
prj = initProject(fileName)
i1 = instruction()
i1.setCircuit(fileName + '.cir')
i1.setSimType('symbolic')
i1.setGainType('gain')
i1.setDataType('laplace')
i1.setSource('V1')
R_ell = sp.Symbol('R_ell')
i1.setDetector('V_i')
result = i1.execute()
V_i = result.laplace
```

I_i

```
i1.setDetector('I_V1')
result = i1.execute()
I_i = -result.laplace
```

V_o

```
i1.setDetector('V_o')
result = i1.execute()
V_o = result.laplace
```

I_o

```
i1.setDetector('I_R2')
result = i1.execute()
I_o = result.laplace
```

T_1

```
A = sp.limit(V_i/V_o, R_ell, 'oo')
B = sp.limit(V_i/I_o, R_ell, 0)
C = sp.limit(I_i/V_o, R_ell, 'oo')
D = sp.limit(I_i/I_o, R_ell, 0)
T1 = sp.Matrix([[A, B], [C, D]])
```